To: NAWMP Evaluation Team

From: Mark Koneff

Subj: June Meeting and related materials

Hi all. Here's an update on the June meeting and some related stuff. We will be meeting on June 10 and 11 in Minneapolis, MN. We have reserved a block of rooms and a meeting room at the Sheraton Inn at the Minneapolis Airport, under U.S. Fish and Wildlife Service. For those of you who make your own travel arrangements, here's the information ...

Sheraton Inn
2500 East 79th Street
Bloomington, MN 55425
612-854-1771 FAX:612-851-8682

We expect that Doug Johnson from the Northern Prairie Science Center and Fred Johnson of the Office of Migratory Bird Management (MBMO) of the Service will also be in attendance. Bob Trost has officially accepted the position of Pacific Flyway Representative and has had to abdicate his seat on the Team. We are not yet certain who his replacement from MBMO will be. Either Tome or myself have talked to all Team members, excluding Trost and expect everyone else to be present in June. Also, a reminder that the August meeting is still scheduled for the week of the 19^{th} somewhere near Ottawa. Clayton R. and Bob B. are coordinating these arrangements.

I met last week with Fred Johnson, Jim Dubovsky, Clint Moore, and Bill Kendall of the Population and Habitat Assessment Section (PHAS), MBMO to discuss the retrospective analyses that we had suggested at the last meeting. I think we made excellent progress in laying the framework for these analyses. I am currently working on a summary of the meeting. I will get this out to you all as soon as all of the meeting participants are comfortable with its contents. We still have no official endorsement from the Office of Migratory Bird Management related to Fred's or PHAS's participation in the retrospective analyses, but I am still hopeful that this will not be a problem.

I've enclosed an "open letter" from myself to the Team which lays out some personal reflections about the continental assessment of the Plan and Adaptive Resource Management. I jotted this down originally as a way to organize my own thoughts on the subject and shared it with Mike Anderson in attempt to reconcile my thoughts with common sense. Mike seemed to think that there was at least some food for thought in the document and suggested I send it to the rest of the Team for consideration for the June meeting. There are certainly conclusions in the documentation that are debatable and I hope we get a chance to discuss some of these in June. At Mike's suggestion, I've added some underlining which hopefully catches certain key points.

Finally, we are starting to think of a specific agenda for the June meeting. We'll try to provide more structure for this meeting than last. I will, of course, circulate the agenda when a draft is completed. See you all soon.

North American Waterfowl Management Plan Continental Assessment:
An Open Letter to the NAWMP Evaluation Team from
M. Koneff

North American waterfowl management has a rich legacy of laws to protect populations from over-exploitation and regulate sport harvest, duck stamp programs and non-profit organizations devoted to raising funds for habitat protection, restoration, and enhancement, and an international infrastructure for continental coordination. Building on this legacy, the North American Waterfowl Management Plan (Plan) represents another great achievement, particularly when measured by the number of partners involved or resources expended ($893 million). Despite Plan partner accomplishments, we close the first decade of Plan implementation still uncertain about the ability of Plan management actions to ultimately achieve its population goals.

This uncertainty is in large part a result of long-standing questions about basic critical relationships between continental waterfowl population processes (survival and recruitment) and the quantity and quality of North American waterfowl habitats. Without addressing these key gaps in understanding, we cannot evaluate the *a priori* hypotheses or assumptions upon which Plan objectives and conservation strategies were based. These *a priori* hypotheses, drawn at both the continental scale and the regional scale of joint venture areas, provide the foundation for the geographical priorities of the Plan and the logic by which habitat conservation goals and strategies were derived for priority habitat areas. In many cases these foundational hypotheses are implicit.

Since the ultimate goal of Plan habitat conservation is to provide sufficient habitat to increase and maintain waterfowl populations, these hypotheses, at their most primal level, relate habitat conservation and management to the key determinants of continental population size: survival and recruitment. Thus, any critical evaluation of Plan implementation and resource allocation is dependent on assessment of the direct, cross-seasonal, or interspatial relationships between survival, recruitment, and habitat. By understanding better how and under what suite of environmental conditions, regional habitats impact continental populations, we can more effectively assess the role of Plan implementation in specific joint ventures, and can identify theoretical "bottlenecks" to population growth or maintenance and conditions which might trigger population bottlenecks.

Two fundamental questions present particularly troublesome problems for managers in allocating resources among Plan priorities and in evaluating the impacts of Plan actions:

(1) What is the role of wintering and migrational habitat in population survival and recruitment (potential cross-seasonal effects) processes and how does this vary in response to population size and environmental conditions in various wintering and migrational areas (potential interspatial effects)?

(2) What is the relationship between upland conditions on the breeding grounds and duck recruitment, hen survival, and subsequent population size and how does this relationship vary in response to spatial clines in water conditions throughout major breeding areas?

It is one important role of the Continental Assessment to address these fundamental gaps in scientific understanding that confound attempts to place the activities and priorities of the North American Waterfowl Management Plan in perspective with a constantly changing continental landscape and the highly dynamic waterfowl populations it supports.

Why are Fundamental Questions in Waterfowl Management Still Questions?

North American waterfowl have been studied more intensely than any other taxonomic group on earth. North American waterfowl managers have devised and implemented population monitoring schemes designed to track annual variation in species continental population sizes which sample vast regions of the continent and are unprecedented in modem wildlife management. Marking studies have also provided a wealth of recovery/resighting data which is useful in estimating population survival rates, as well as in identifying "manageable" subpopulation units. Moreover, intense research and monitoring have been on-going for nearly 50 years. Given this effort, it is initially difficult to comprehend biologists' inability to more definitively identify the dynamic effects of habitat on the growth and decline of continental waterfowl populations. The extreme complexity of the continental system being managed has understandably contributed to these information gaps, as has the cost and logistical difficulty associated with studying processes operating at such broad-scales. In addition to these more obvious problems, unfortunate properties of existing broad-scale monitoring data sets limit the ability of retrospective analyses using historical data to better describe key population processes and broad-scale factors affecting these processes. To understand why we do not know more about these functional relationships, it is important to examine the purpose for which the current system of waterfowl population monitoring was developed, and the historical use of the data in guiding management action. The monitoring programs in place today were developed primarily as tools in the regulation of waterfowl sport harvest.

Since the development of monitoring programs and the evolution of appropriate data analysis procedures, harvest regulation has essentially followed a general adaptive approach to management. The general adaptive approach to management involves an iterative cycle of resource monitoring, biological assessment, arid decision-making. Through monitoring programs, resource status (waterfowl population size and wetland conditions) is updated annually. Then through an assessment process, managers attempt to provide a sound biological basis for a decision on harvest regulation given the data collected during the prior monitoring efforts. Assimilating the conclusions of the assessment, managers arrive at an appropriate harvest decision given the resource status. Historically, decisions on harvest regulations, while taking into account current habitat and population status were somewhat subjective and did little to resolve long-standing debates about the role of harvest regulation in population management. Over time the regulations process had evolved into a fairly conservative, risk-aversive process in which regulated harvest opportunity tightly tracked changes in population size.

The conservative harvest management process which had developed since the 1950s unfortunately had ramifications on the study of continental waterfowl population dynamics by affecting the usefulness of the monitoring data sets currently available to managers. This is a result of autocorrelation over time among environmental, population (density-dependent), and management (harvest) effects which has been injected into the data sets as harvest regulations chased populations (Nichols et al. 1995, Walters 1986, Williams and Johnson 1995). For instance, when consecutive drought years leave the prairie pothole region very dry, overall recruitment of mallards plummets, and continental population size declines to a low level. The conservative harvest management action would be to restrict harvest on mallards significantly. When environmental conditions again favor mallard production, and population size increases, it is impossible to discern the extent to which this recovery is a result of management, the extent to which it is due to improved habitat conditions, and the role of density-dependence throughout the population decline and recovery cycle. Walters (1986) labels this situation a "confounding of environment versus management" and notes that over time it can evolve into divergent views over the fundamental role of management.

With Current Limitations How Can a *Continental Assessment of the Plan Proceed?*

Regardless of the unfortunate situation described in the previous section, waterfowl managers are still blessed with a tremendous base of scientific literature assembled primarily since World War II. This information, in conjunction with the large monitoring and marking data sets currently available, provide a wealth of data from which plausible hypotheses about key relationships between the quantity and quality of continental waterfowl habitats and population processes can be developed.

The North American Waterfowl Management Plan Evaluation Team (Evaluation Team) has been charged to address the need for a Continental Evaluation of the Plan. Although the Evaluation Team developed a framework for joint venture evaluation following the general adaptive approach to management over 4 years ago, methods to evaluate the overall continental impact of the Plan and provide guidance for future resource allocation have been slow to develop. The Evaluation Team is currently studying the potential for elements of the formal "Adaptive Resource Management" framework to assist in addressing fundamental gaps in our understanding of survival-recruitment-habitat functional relationships. Clarifying these relationships is thus considered one of the objectives of the Continental Assessment since they are foundational to the objectives and strategies of the Plan. It is currently unclear whether it is feasible to expect that these procedures could assist in an evaluation of the "effect" of Plan implementation on continental waterfowl populations, however, we might expect to at least be able to infer the relative magnitude of Plan impact given the habitat-population relationships which can be identified over time, tracking information on Plan accomplishments and properly structured habitat monitoring efforts which provide information on cumulative landscape change in key habitat areas.

What's Adaptive Resource Management, and How Can It Help Us in the Continental Assessment?

Adaptive Resource Management (ARM) is a formal, quantitative application of the general adaptive approach to management that explicitly recognizes the uncertainty about management effects and actively seeks to provide information which is useful in learning about the underlying dynamics of the system being managed (Williams and Johnson 1995). This definition of ARM refers to what has become known as "Active Adaptive Management" and is contrasted with "Passive Adaptive Management" (Walters and Holling 1990). Passive Adaptive Management involves the use of historical data to construct one "best" model of the dynamics of a managed system which is assumed "correct" and provides a basis for management decisions. The setting of waterfowl harvest regulations has followed the passively adaptive approach to management, with its associated disadvantages, as already described.

Walters (1986) lists several basic components of an actively adaptive management strategy: (1) a bounded set of potential management actions, (2) a suite of alternate quantitative system models which predict system response to management based on different hypotheses about system dynamics, (3) representation of uncertainty and methods to track it through time in relation to management actions, and (4) explicit, dual management objectives that account for short-term benefits associated with resource production and long-term benefits to resource utilization which can be expected as a result of understanding the system better. The key differentiation from passive strategies is that active strategies incorporate learning as a specific goal of management, to the extent that the information obtained will help managers meet the traditional management objectives (Williams and Johnson 1995).

In 1995, the U.S. Fish and Wildlife Service began implementation of Adaptive Harvest Management (AHM), which employs the framework of Active ARM in the regulation of waterfowl harvest. AHM was developed cooperatively over a period of several years by the AHM Working Group, a committee of Federal and State government agency and non-profit conservation organization representatives with stakes in the regulation process. Consistent with the components of an active strategy, the Working Group identified a limited set of potential management options (regulations packages), a suite of models which quantify different hypotheses about population dynamics and the affects of harvest management, an uncertainty measure for each model, and an explicit objective function (an equation representing harvest management objectives).

The objective function describing harvest management objectives which was developed by the AHM Working Group consolidates two potentially competing objectives of waterfowl management: maintenance of populations and maximization of harvest opportunity. The objective function, by weighing both these factors quantitatively, eliminates disagreement based on different perceptions about relative dominance of these issues. The Working Group used the population goals of the Plan as a benchmark by which to assign relative weight to harvest versus population growth. When populations are near Plan goals, the objective function places greater emphasis on harvest opportunity. The population objectives of the Plan were chosen for this purpose because they are supported by the federal governments of Canada, Mexico, and the U.S., and they were originally established to permit acceptable levels of harvest and maintain populations consistent with other non-consumptive purposes (Anonymous 1986, Williams and Johnson 1995).

The actual methods by which AHM determines optimal harvest management actions are computationally complex and have been elsewhere described (Williams 1988, 1989; Lubow 1995). The ultimate goal of the process is to select regulations packages in the present that will maximize, to the extent possible, both present and future harvest while remaining consistent with the stated objectives of management. Explicit in this approach is the realization that the optimal management solution will only be achieved by identifying the model which performs best in describing population dynamics and the effects of harvest (Williams and Johnson 1995). The AHM process is structured such that information which will identify the most appropriate system model accrues over time. <u>The rate at which this "learning" can occur is highly dependent on the adequacy of the models in the alternative model suite. Therefore, a search to improve the predictive abilities of the models is on-going, with current emphasis being placed on the incorporation of habitat parameters and better representation of the effect of these parameters on populations.</u>

<u>It has been suggested that the conceptual framework of ARM and AHM could be similarly applied to the management of waterfowl habitats (Evaluation Team unpublished report. Johnson et al. 1996). In applying an ARM framework. formal linkages would be developed between Plan implementation and evaluation/assessment. While the concept is logical and intriguing, many formidable technical, logistical and institutional challenges exist which will be difficult to overcome in practice.</u> These difficulties loom even larger when the time required to implement and learn from such changes is considered. The North American Waterfowl Management Plan

established an initial 15-year horizon for implementation. May of 1996 marks the 10th anniversary of the signing of the Plan and a decade of habitat conservation action. In general, implementation has lagged behind the rates needed to achieve Plan habitat goals by 2001, the original target for meeting those goals. While conservation activities have lagged behind schedule overall, Plan partners have made tremendous strides, to date dedicating nearly $900 million to meeting Plan conservation objectives. Federal funds, while only a fraction of this total, have been dedicated to the Plan and associated conservation programs and are important partnership seed monies which are in jeopardy of being lost or significantly reduced during an era of downsizing. <u>The tremendous expenditures to date and the threats to future fiscal partnerships add an air of urgency to the development of effective evaluation mechanisms at both the joint venture and continental scale which provide feedback for any needed mid-course changes in Plan priorities or implementation strategies.</u>

<u>Several challenging technical and institutional obstacles exist which would appear to thwart a swift application of the ARM framework to waterfowl habitat management.</u> The major technical obstacles relate to the differences in large-scale population response to habitat versus harvest management and a lack of habitat monitoring programs to provide timely feedback on habitat status for assessment. The impact of a particular set of annual harvest regulations on waterfowl populations is relatively rapid and is confined to the subsequent hunting season. Monitoring programs in place can provide timely data to assist in discriminating the impact of the harvest management action on the population. This is contrasted with the situation which exists for waterfowl habitat management where conservation actions are often protracted, population response to actions may not be immediately detectable at any scale, and for which monitoring programs do not exist to track changes in overall landscape conditions with respect to Plan conservation activities. In addition to these formidable technical issues, the decentralized decision-making process and the diffusion of management authority over many jurisdictional levels which characterize the Plan and waterfowl habitat management in general severely constrains management "control" and coordination. This is unlike the situation faced in harvest management where a central, controlling authority exists (Johnson et al. 1996).

<u>With time, patience and persistence managers could overcome many of the obstacles to a true application of ARM for waterfowl habitat and harvest management. However, what is the potential for the ARM approach to assist with continental assessment of the Plan in the near-term?</u> Waterfowl harvest and habitat management have converged on identical goals which place explicit value on both the maintenance of populations and the maximization of harvest opportunity. The AHM Working Group continues to emphasize the need for improvement of the AHM model suite by better describing the effects of habitat on population dynamics. The same fundamental questions regarding the nature of habitat-population relationships plague the Evaluation Team and other Plan partners as they attempt to evaluate progress and provide guidance on implementation priorities. <u>Taken together these factors suggest a opportunity to "piggyback" the efforts of the AHM Working Group and the Evaluation Team in order to address these fundamental questions by augmenting the existing model suite used in AHM with alternative hypotheses about the dynamic effects of habitat on waterfowl populations.</u>

While the obstacles already discussed make it unlikely that the ARM process would permit the discrimination of the specific effect of Plan conservation actions on continental populations, it may be possible to shed light on problematic questions about broad-scale habitat-population relationships. <u>If a goal of the Continental Assessment is to address these fundamental questions, then it is not critical to identify a "detectable effect" of habitat conservation versus environmental and human development activities on populations.</u> The lack of the centralized management authority which would be necessary to intentionally and in a coordinated fashion, perturb the system at scales large enough to produce measurable effects on populations is also not a barrier to addressing these fundamental questions. In a sense, we can get the system perturbations necessary to learn about habitat-population relationships for "free." If the cumulative landscape effects of habitat conservation and management habitat losses through development and temporary but often dramatic fluctuation in available habitat due to environmental conditions are considered analogous to a "management action", then tremendous informative variation exists within the system which would be useful in learning about these fundamental relationships by utilizing the ARM conceptual framework.

Ability, in the near-term, to extend this framework further and at least draw inferences about the relative continental impact of Plan activities would be dependent on the methods used to incorporate data on waterfowl habitat quantity and quality into the AHM models. For instance, habitat in major waterfowl habitat areas can be monitored and incorporated into model parameters as correlates to habitat conditions or, given reallocated survey effort, it may be possible to monitor and estimate actual habitat availability. While correlates to habitat quantity and quality (i.e., precipitation and drought indices in major habitat areas) may be useful in learning about these fundamental relationships, it would be difficult to infer anything about the relative magnitude of Plan effects on populations. However, it is feasible that current monitoring efforts could be restructured to provide reasonable estimates of actual waterfowl habitat availability in key breeding, migrational, and wintering areas at some appropriate time interval. Functional relationships identified through the ARM process between waterfowl survival and recruitment and estimated habitat availability would then tend to be more "mechanistic" in that they relate actual habitat, rather than a correlate of habitat, to population response. Simulations using newly identified "mechanistic" relationships between habitat and populations would be useful in identifying how the importance of various habitats and habitat areas changes with geographic and temporal variations in landscape conditions, population size and harvest. Such simulations therefore could provide a means to draw inferences about the appropriateness of Plan goals (how much habitat and where?) and the relative magnitude of Plan impacts with respect to net landscape change.

Conclusion

There are obvious advantages to more formal integration of waterfowl habitat and harvest management. While obstacles exist, there are presently significant opportunities for partial integration of these efforts which could provide needed information to improve harvest regulation as well as Plan implementation. The information needs for effective assessment of the impact of harvest regulation and Plan associated habitat conservation have converged. To address these needs, the North American Waterfowl Management Plan Evaluation Team and the Adaptive Harvest Management Working Group should combine efforts to study methods to incorporate appropriate habitat parameters and critical hypotheses about the effect of habitats on waterfowl population processes into population models. If appropriate estimates or correlates of habitat can be developed and key hypotheses regarding the effect of habitat on population processes can be codified into quantitative models, the models competing in AHM could be augmented with these relationships. By adding these factors to the competing models, "learning" rates for harvest management could be improved while simultaneously addressing several critical needs of the continental assessment of the North American Waterfowl Management Plan.

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